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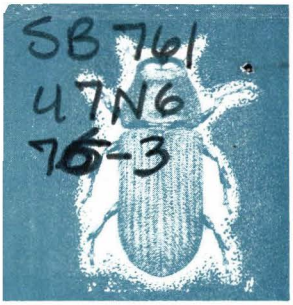

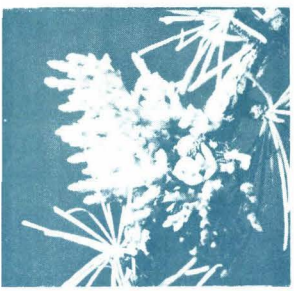

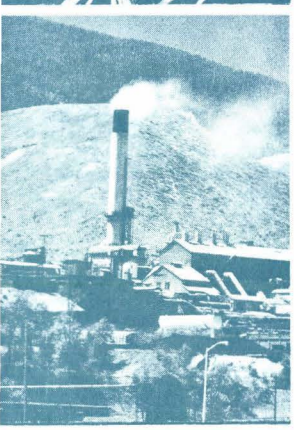

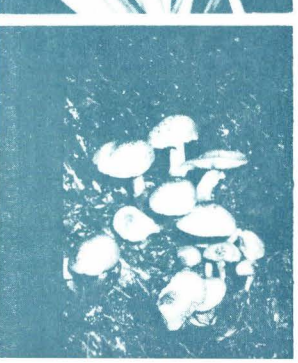

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HARVESTING STRATEGIES FOR MANAGEMENT OF MOUNTAIN PINE BEETLE INFESTATIONS IN LODGEPOLE PINE, MONTANA. PROGRESS REPORT

By

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INTRODUCTION

Epidemic infestations of mountain pine beetle, *Dendroctonus ponderosae* Hopk., developed on the Gallatin National Forest in 1969-70 (3, 6, 7).

Infestations occurred in stands composed of 75 to 100 percent lodgepole pine. By 1973, 27 percent of the lodgepole pine component on the Gallatin District had been killed by the beetle (8); by 1975, the loss of merchantable timber in areas surveyed in the Gallatin Canyon increased to 39 percent. There has been a total loss of nearly 20 million board feet in these areas (9).

Operational control by felling and burning and salvage logging of infested trees was initiated in the Gallatin Canyon in 1971. This action did little to slow the impetus of the outbreak, because the entire infestation could not be treated.

Recent studies of lodgepole pine stands in Colorado, by Cole and Cahill (4), have shown that probabilities of loss can be developed based on phloem-diameter distributions. They demonstrated that harvesting strategies could be implemented based on probabilities of loss to eliminate or greatly reduce mountain pine beetle epidemic potential.

Based on their findings, a cooperative study was established (5) to determine if silvicultural methods can be used to manage mountain pine beetle in lodgepole pine stands.

The study is intended to develop more fully the proposed harvesting strategies. Presented here are the methods and results of the first year of this effort to manage mountain pine beetle populations.

METHODS

Six 40-acre blocks of lodgepole pine, containing current mountain pine beetle infestations, were selected on the Gallatin National Forest, Montana, in 1974. Each block was to receive one of the following harvesting plans prior to beetle flight in 1975:

1. Remove all infested and green trees above 12 inches d.b.h., regardless of phloem thickness.

2. Remove all infested and green trees above 10 inches d.b.h., regardless of phloem thickness.

3. Remove all infested and green trees above 7 inches d.b.h., regardless of phloem thickness.

4. Remove all infested and green trees where one or both bark samples indicate a phloem thickness $\geq$ 0.10 inch (based on two bark chip samples taken at breast height from each tree); minimum diameter to be 8 inches d.b.h.

5. Remove no trees on two check blocks.

Although the study plan called for harvesting of the study areas prior to emergence of adult beetles in 1975, only two areas were logged--the 7-inch cut block and major portions of the 12-inch cut block. As a result of not completing the harvest, resurvey of these areas was required.

Within each of the study blocks, except the Hellroaring Creek check block, 100 percent cruises were conducted to determine new levels of beetle infestation and average phloem thickness of 1975 attacked trees. In the Hellroaring Creek check block, forty 1/4-acre plots were taken to determine levels of beetle infestation and phloem thicknesses.

In all plots, each attacked tree was recorded by species, diameter at breast height, and categorized as to year of attack.

RESULTS

Descriptions and preharvest analyses of each study area were prepared for the 1975 Establishment Report (5). Presented here are the results of resurvey for all areas which provide the preharvest baseline for the expected harvest in 1976. A summary of resurvey sampling is presented in Table 1.

Table 1.--Summary of resurvey sampling for mountain pine beetle study plots, Gallatin National Forest, Montana, 1975.

Location	Mean No. of infested trees/acre	Mean diameter of 1975 attacked trees	Mean phloem thickness of 1975 attacked trees	% of phloem samples from attacked trees ≥ 0.10 inch
Hebgen Lake R.D.				
7-inch cut block*	0.2	7.17	0.1058	83.3
10-inch cut block	4.2	12.25	.0945	60.1
Phloem cut block	4.1	11.34	.0858	48.8
Check block (A)	2.8	10.50	.0873	58.4
Gallatin R.D.				
12-inch cut block*	1.3	13.32	.0927	60.4
Check block (B)	78.0	8.74	.0877	52.6

*Postharvest figures.

Hebgen Lake District

The mountain pine beetle infestation which developed on the Hebgen Lake District in 1970 (3, 6) has continued at epidemic level throughout the stand where four of the study blocks are located.

7-inch cut block.--Harvesting of infested and all green trees above 7 inches d.b.h. was completed in this block in 1974. As a result of harvesting, only six 1975 attacked trees were located in the 40-acre block. Five of the six infested trees were 7 inches d.b.h. or greater and were missed during the harvest. Mean diameter and phloem thickness of 1975 attacked trees was 7.17 inches and 0.1058 inch. Based on phloem samples taken from 1975 attacked trees, 57.1 percent had mean phloem thickness greater than or equal to 0.10 inch.

10-inch cut block.--The harvesting strategy for this block was to remove all infested and all green trees 10 inches d.b.h. and greater. Resurvey of the area indicated a mean of 4.2 infested trees per acre in 1975. This compared to 2.3 infested trees per acre in 1974, a 1:1.82 buildup ratio. Mean d.b.h. and phloem thickness of newly attacked trees were

12.25 inches and 0.0945 inch respectively. Eighty-nine percent of the newly attacked trees were 10 inches or larger and were marked for harvest. Mean diameter and phloem thickness of the remaining 11 percent unmarked 1975 attacked trees were 8.95 inches and 0.0855 inch respectively. Based on phloem samples taken from 1975 attacked trees, 43.7 percent had mean phloem thickness greater than or equal to 0.10 inch.

Phloem cut block.--Harvest of all infested and green trees with a phloem thickness of 0.10 inch and greater was to occur in 1975. Resurvey indicated an average of 4.1 currently infested trees per acre, which was double the number of infested trees per acre in 1974. Mean d.b.h. and phloem thickness of newly attacked trees were 11.34 inches and 0.0858 inch respectively. Ninety-two percent of the newly attacked trees had been marked for harvest. Mean diameter and phloem thickness of the remaining 8 percent unmarked 1975 attacked trees were 10.38 inches and 0.0724 inch respectively. Based on phloem samples taken from 1975 attacked trees, 27.4 percent had mean phloem thickness greater than or equal to 0.10 inch.

Check block (A).--The check block established adjacent to the 7-inch cut block remained undisturbed with regard to harvesting. Survey of the area was conducted to determine buildup ratio. Mean number of currently infested trees per acre was 2.83 in 1975. This compared to 2.30 for 1974 or a ratio of 1:1.23. Mean d.b.h. and phloem thickness of 1975 attacked trees was 10.50 inches and 0.0873 inch respectively. Based on phloem samples taken from 1975 attacked trees, 27.4 percent had mean phloem thickness greater than or equal to 0.10 inch.

Gallatin District

The mountain pine beetle infestation on the Gallatin District has continued at epidemic levels since 1969 (7, 9). Two study plots are within the area of infestation.

12-inch cut block.--Harvest of all infested and green trees above 12 inches d.b.h. was to be completed in this study area prior to beetle flight in 1975. Although harvest of all 1974 attacked trees containing brood was completed, the remaining green component was not removed prior to the harvest deadline. As a result, 41 trees marked for removal (i.e., 12 inches d.b.h. or greater) were attacked in 1975. In addition, 12 unmarked (i.e., less than 12 inches d.b.h.) trees were attacked. Mean diameter and phloem thickness of 1975 attacked trees were 13.32 inches and 0.0927 inch respectively. Based on phloem samples taken from 1975 attacked trees, 35.9 percent had mean phloem thickness greater than or equal to 0.10 inch.

Check block (B).--A second check block was established along Hellroaring Creek in an area of extremely heavy infestation. This block remained undisturbed with regard to harvesting. Survey of the area was conducted

to determine current buildup ratio. Average number of infested trees per acre was 78.0 in 1975. This compared to 11.8 for 1974, or a 1:6.6 buildup ratio. Mean d.b.h. and phloem thickness of 1975 attacked trees was 8.74 inches and 0.0877 inch respectively. Based on phloem samples taken from 1975 attacked trees, 31.6 percent had mean phloem thickness greater than or equal to 0.10 inch.

DISCUSSION

Since mountain pine beetle brood production has been shown to be positively correlated with phloem thickness (1) and phloem thickness positively correlated with tree diameter (2), then distributions of phloem thickness over diameter become effective measurements for evaluating infestation potentials in lodgepole pine stands. Based on these same measurements, it is possible to implement certain harvesting strategies to eliminate or at least greatly reduce mountain pine beetle epidemic potential (4). By selectively logging those trees or diameter classes of trees which are most susceptible to attack, suitable host material for beetle production can be eliminated. To field test this theory, study plots were established and given certain cutting prescriptions for 1975. Unfortunately, it was not possible to complete the harvest according to specifications and only preliminary results are available. Groundwork is set, however, for completion of the study over the next 3 years.

In the 7-inch cut block, all trees greater than 7 inches d.b.h. were cut regardless of phloem depth. Harvest of the block was completed in 1974 and postharvest sanitation was being completed in late 1975. Essentially, the entire range of host material was eliminated since mountain pine beetle prefers large diameter trees and survival has been shown to be greater in them (2). It was predicted in the 1974 Establishment Report (5) that, (a) future infestation levels in the 7-inch cut block would be minimal, and (b) trees attacked would have thicker than average phloem for their tree diameter class. In a 100 percent cruise of the block, only six newly infested trees were located and mean phloem thickness of these trees was 0.1058 inch, whereas the mean for the 7-inch diameter class in this stand in 1974 was 0.0634 inch.

Harvest in the 10-inch cut block theoretically would have removed the majority of susceptible host material, particularly large diameter trees with thick phloem. If harvest had been completed, 149 of the 168 newly attacked trees would not have remained in the stand to be attacked. The unmarked (i.e., less than 10 inches d.b.h.) trees in the stand, which were attacked averaged 8.95 inches d.b.h. and had a mean phloem thickness of 0.0855 inch.

The selective harvesting plan for the 12-inch cut area was to remove all trees 12 inches d.b.h. and greater regardless of phloem thickness. A contract was let to log this area with horses in 1975. Although all 1974 infested trees were removed prior to beetle flight in 1975, the

majority of marked green trees 12 inches d.b.h. and larger were not. As a result, 41 green trees marked for removal (i.e., 12 inches and greater d.b.h.) were attacked in 1975. Only 12 unmarked trees (i.e., less than 12 inches d.b.h.) were attacked and 50 percent of those were pitchouts. Mean diameter and phloem thickness of unmarked, attacked trees were 10.50 inches and 0.0871 inch respectively. Cleanup of downed trees and removal of the remainder of infested and marked trees should result in a continued decline in infestation levels in 1976.

Resurvey of the phloem cut block indicated that 151 green trees marked for removal (i.e., with phloem greater than or equal to 0.10 inch) were attacked in 1975. In addition, 13 unmarked green trees (i.e., with phloem less than 0.10 inch) were attacked. Mean diameter and phloem thickness of the unmarked attacked trees were 10.38 inches and 0.0723 inch respectively. Number of infested trees per acre should be lower in 1976 if the marked and infested trees can be removed prior to beetle flight.

Although the overall purpose of this harvesting strategies study has been delayed 1 year, it is expected that as a selected proportion of the larger diameter trees and those with a phloem thickness greater than or equal to 0.10 inch are removed from each study area, infestation levels will decline. A reduction in beetle populations should result because trees having thin phloem produce fewer beetles per unit area of bark, and beetles completing development in small trees having thin phloem are usually smaller than beetles completing development in larger trees (10), adversely affecting population quality.

The reduction in infestation levels in each study area is expected to be proportional to the amount of large diameter or thick phloemed, susceptible timber removed. The two check blocks, where no harvesting will occur, are expected to continue at epidemic levels and provide a basis for comparison of the treatments.

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